What is claimed is:

1. A method for optimizing an illumination source for a mask illumination comprising the steps of:

providing illumination from an illumination source to a plurality of source points and a predetermined mask pattern;

selecting fragmentation points in an image plane of an image formed by the illumination provided to the predetermined mask pattern;

determining an intensity and image log slope of illumination at each fragmentation point;

determining an optimal illumination source as an illumination source which maximizes the image log slope at the selected fragmentation points and has an intensity within a predetermined range.

2. The method of claim 1, further providing the step of providing optimization constraints on the optimal illumination source.

3. The method of claim 1, wherein the step of determining the intensity and shape of the illumination source, determines an optimal illumination source as one which forces illumination intensity at the image plane to a predetermined value.

4. The method of claim 1, wherein the step of determining an optimal illumination source determines an optimal shape of the illumination source.

5. The method of claim 1, wherein the step of determining an optimal illumination source determines an optimal intensity of the illumination source.

6. A method for determining an optimal mask comprising the steps of:

determining optimum diffraction orders of an ideal mask;

obtaining an optimal transmission mask based on the optimized diffraction orders of the ideal mask; and

determining an optimal mask based on the optimal transmission mask,

wherein the optimum diffraction orders of the ideal mask are determined by determining a magnitude and phase of diffraction orders which form an image in an image plane which maximizes the minimum illumination log slope at user selected fragmentation points while forcing an intensity of illumination at the fragmentation points to be within a predetermined range.

7. The method of claim 6, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining horizontal diffraction orders of an optimum mask, wherein the number of horizontal diffraction orders is determined according to the equation:

$$m = 2\,floor\left[\frac{P_x(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where m is the number of horizontal diffraction orders;

P_x is the pitch of the repetitive cell in the x direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

8. The method of claim 6, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining vertical diffraction orders of an optimum mask, wherein the number of vertical diffraction orders is determined according to the equation

$$n = 2\,floor\left[\frac{P_y(\sigma_{\max}+1)NA}{\lambda}\right]+1$$

where n is the number of vertical diffraction orders;

P_y is the pitch of the repetitive cell in the y direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

9. The method of claim 6, wherein the step of determining optimum diffraction orders determines optimum diffraction orders in the special frequency domain.

10. The method of claim 6, wherein the step of determining an optimum mask comprises the steps of:

locating areas of maximum transmission and minimum transmission;

assigning a primitive area as an area centered on an area of maximum transmission or minimum transmission;

varying edges of each primitive area to match optimal diffraction orders,

wherein each primitive areas has a minimum size which is substantially equal to a minimum feature size of the mask.

11. A method of obtaining an optimum source and an optimum mask comprising the steps of:

providing illumination from an illumination source to a plurality of source points and a predetermined mask pattern;

selecting fragmentation points in an image plane of an image formed by the illumination provided to the predetermined mask pattern;

determining an intensity and image log slope of illumination at each fragmentation point; and

simultaneously changing the intensity and shape of the illumination source and the magnitude and phase of diffraction orders of the mask to form an image in the image plane that maximizes the minimum image log slop at the fragmentation points while forcing the intensity at the fragmentation points to be within a predetermined intensity range.

12. A method of optimizing a placement of transmission and phase shifting features on a mask comprising the steps of:

obtaining optimal mask transmission characteristics based on optimum diffraction orders of the mask;

locating areas of maximum transmission and minimum transmission;

assigning a primitive area as an area centered on an area of maximum transmission or minimum transmission;

varying edges of each primitive area to match optimal diffraction orders,

wherein each primitive area has a minimum size which is substantially equal to a minimum feature size of the mask.

13. The method of claim 12, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining horizontal diffraction orders of an optimum mask, wherein the number of horizontal diffraction orders is determined according to the equation:

$$m = 2\,floor\left[\frac{P_x(\sigma_{\max}+1)NA}{\lambda}\right]+1$$

where m is the number of horizontal diffraction orders;

P_x is the pitch of the repetitive cell in the x direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

14. The method of claim 12, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining vertical diffraction orders of an optimum mask, wherein the number of vertical diffraction orders is determined according to the equation

$$n = 2\,floor\left[\frac{P_y(\sigma_{\max}+1)NA}{\lambda}\right]+1$$

where n is the number of vertical diffraction orders;

P_y is the pitch of the repetitive cell in the y direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

15. The method of claim 12, wherein the mask is a CPL mask.

16. A computer readable medium containing instructions for a computer to cause optimizing an illumination source for a mask illumination comprising the steps of:

providing illumination from an illumination source to a plurality of source points and a predetermined mask pattern;

selecting fragmentation points in an image plane of an image formed by the illumination provided to the predetermined mask pattern;

determining an intensity and image log slope of illumination at each fragmentation point;

determining an optimal illumination source as an illumination source which maximizes the image log slope at the selected fragmentation points and has an intensity within a predetermined range.

17. The computer readable medium of claim 16, further containing instructions for a computer to cause the step of providing optimization constraints on the optimal illumination source.

18. The computer readable medium of claim 16, wherein the step of determining the intensity and shape of the illumination source, determines an optimal illumination source as one which forces illumination intensity at the image plane to a predetermined value.

19. The computer readable medium of claim 16, wherein the step of determining an optimal illumination source determines an optimal shape of the illumination source.

20. The computer readable medium of claim 16, wherein the step of determining an optimal illumination source determines an optimal intensity of the illumination source.

21. A computer readable medium containing instructions for a computer to perform a method for determining an optimal mask comprising the steps of:

determining optimum diffraction orders of an ideal mask;

obtaining an optimal transmission mask based on the optimized diffraction orders of the ideal mask; and

determining an optimal mask based on the optimal transmission mask,

wherein the optimum diffraction orders of the ideal mask are determined by determining a magnitude and phase of diffraction orders which form an image in an image plane which maximizes the minimum illumination log slope at user selected fragmentation points while forcing an intensity of illumination at the fragmentation points to be within a predetermined range.

22. The computer readable medium of claim 21, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining horizontal diffraction orders of an optimum mask, wherein the number of horizontal diffraction orders is determined according to the equation:

$$m = 2\,floor\left[\frac{P_x(\sigma_{\max}+1)NA}{\lambda}\right]+1$$

where m is the number of horizontal diffraction orders;

P_x is the pitch of the repetitive cell in the x direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

23. The computer readable medium of claim 21, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining vertical diffraction orders of an optimum mask, wherein the number of vertical diffraction orders is determined according to the equation

$$n = 2\,floor\left[\frac{P_y(\sigma_{\max}+1)NA}{\lambda}\right]+1$$

where n is the number of vertical diffraction orders;

P_y is the pitch of the repetitive cell in the y direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

24. The method of claim 21, wherein the step of determining optimum diffraction orders determines optimum diffraction orders in the special frequency domain.

25. The computer readable medium of claim 21, wherein the step of determining an optimum mask comprises the steps of:

locating areas of maximum transmission and minimum transmission;

assigning a primitive area as an area centered on an area of maximum transmission or minimum transmission;

varying edges of each primitive area to match optimal diffraction orders,

wherein each primitive areas has a minimum size which is substantially equal to a minimum feature size of the mask.

26. A computer readable medium containing instructions for a computer to perform a method of obtaining an optimum source and an optimum mask comprising the steps of:

providing illumination from an illumination source to a plurality of source points and a predetermined mask pattern;

selecting fragmentation points in an image plane of an image formed by the illumination provided to the predetermined mask pattern;

determining an intensity and image log slope of illumination at each fragmentation point; and

simultaneously changing the intensity and shape of the illumination source and the magnitude and phase of diffraction orders of the mask to form an image in the image plane that maximizes the minimum image log slop at the fragmentation points while forcing the intensity at the fragmentation points to be within a predetermined intensity range.

27. A computer readable medium containing instructions for a computer to cause optimizing a placement of transmission and phase shifting features on a mask comprising the steps of:

obtaining optimal mask transmission characteristics based on optimum diffraction order of the mask;

locating areas of maximum transmission and minimum transmission;

assigning a primitive area as an area centered on an area of maximum transmission or minimum transmission;

varying edges of each primitive area to match optimal diffraction orders,

wherein each primitive area has a minimum size which is substantially equal to a minimum feature size of the mask.

28. The computer readable medium of claim 27, wherein the mask is a CPL mask.

29. The computer readable medium of claim 27, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining horizontal diffraction orders of an optimum mask, wherein the number of horizontal diffraction orders is determined according to the equation

$$m = 2\,floor\left[\frac{P_x(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where m is the number of horizontal diffraction orders;

P_x is the pitch of the repetitive cell in the x direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

30. The computer readable medium of claim 27, wherein the step of obtaining optimal mask transmission characteristics includes a step of determining vertical diffraction orders of an optimum mask, wherein the number of vertical diffraction orders is determined according to the equation:

$$n = 2\,floor\left[\frac{P_y(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where n is the number of vertical diffraction orders;

P_y is the pitch of the repetitive cell in the y direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

31. An apparatus for optimizing an illumination source for a mask illumination comprising:

an input unit which inputs characteristics of an illumination device; and

a processing unit which is configured to change an intensity and shape of an illumination to form an image in an image plane that maximizes the minimum image log slope at user selected fragmentation points.

32. The apparatus of claim 31, wherein the processing unit is further configured to forcing the intensity at the fragmentation points to be within a predetermined intensity range.

33. An apparatus for optimizing an mask comprising:

an input unit which inputs a desired image pattern; and

a processing unit which is configured to change a magnitude and phase of diffraction orders to form an image in the image plane that maximizes the minimum image log slope at user selected fragmentation points while forcing the intensity at the fragmentation points to be within a predetermined intensity range.

34. The apparatus of claim 33, wherein the processing unit is further configured to obtain optimal mask transmission characteristics by determining horizontal diffraction orders of an optimum mask, wherein the number of horizontal diffraction orders is determined according to the equation:

$$m = 2\,floor\left[\frac{P_x(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where m is the number of horizontal diffraction orders;

P_x is the pitch of the repetitive cell in the x direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

35. The apparatus of claim 33, wherein the processing unit is further configured to obtain optimal mask transmission characteristics by determining vertical diffraction orders of an optimum mask, wherein the number of vertical diffraction orders is determined according to the equation

$$n = 2\,floor\left[\frac{P_y(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where n is the number of vertical diffraction orders;

P_y is the pitch of the repetitive cell in the y direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

36. The apparatus of claim 33, wherein the step of determining optimum diffraction orders determines optimum diffraction orders in the special frequency domain.

37. The apparatus of claim 33, wherein the processing unit is further configured to obtain optimal mask by locating areas of maximum transmission and minimum transmission; assigning a primitive area as an area centered on an area of maximum transmission or minimum transmission; and varying edges of each primitive area to match optimal diffraction orders,

wherein each primitive areas has a minimum size which is substantially equal to a minimum feature size of the mask.

38. An apparatus for obtaining an optimum source and an optimum mask comprising:

an input unit which accepts user inputs; and

a processing unit configured to simultaneously change an intensity and shape of an illumination source and change a magnitude and phase of diffraction orders to form an image in an image plane which maximizes a minimum image log slope at user selected fragmentation points while forcing an intensity at the fragmentation points to be within a predetermined intensity range.

39. An apparatus for optimizing a placement of transmission and phase shifting features on a mask comprising:

an input unit which inputs characteristics of an illumination device; and

a processing unit which is configured to obtain optimal mask transmission characteristics based on optimum diffraction orders, locate areas of minimum transmission and maximum transmission, assign primitive areas as areas centered on an area of minimum transmission or an area of maximum transmission, and vary edges of the primitive area to match optimal diffraction orders,

wherein the primitive areas have a minimum size which is substantially equal to a minimum feature size of the mask.

40. The apparatus of claim 39, wherein the mask is a CPL mask.

41. The apparatus of claim 39, wherein the optimal mask transmission characteristics include horizontal diffraction orders of an optimum mask, and the number of horizontal diffraction orders is determined according to the equation

$$m = 2\,floor\left[\frac{P_x(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where m is the number of horizontal diffraction orders;

P_x is the pitch of the repetitive cell in the x direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.

42. The apparatus of claim 39, wherein the optimal mask transmission characteristics include vertical diffraction orders of an optimum mask, wherein the number of vertical diffraction orders is determined according to the equation:

$$n = 2\,floor\left[\frac{P_y(\sigma_{\max} + 1)NA}{\lambda}\right] + 1$$

where n is the number of vertical diffraction orders;

P_y is the pitch of the repetitive cell in the y direction;

λ is a wavelength of the illumination source;

NA is a numerical aperture of the projection optics; and

σ_{max} is a radial extent of the distribution of a beam of light from the illumination source.